

TECHNICAL SPECIFICATION

FOR

**INTEGRATED PURIFIED WATER
SYSTEM FOR LABORATORY**

INDEX

S. NO.	SUB HEAD	PAGE NO.
1	SCOPE OF WORK	2
2	TECHNICAL SPECIFICATION FOR INTEGRATED PURIFIED WATERSYSTEM FOR LABORATORY	3
3	TECHNICAL SPECIFICATIONS	6
4	LIST OF INDICATIVE MAKES	12
5	DRAWINGS AND DATA	12
6	GENERAL GUIDELINES FOR PIPING	13
7	GENERAL TECHNICAL SPECIFICATION OF PIPES AND FITTINGS	18

1.0 SCOPE OF WORK

The scope of work includes design, supply, installation/ erection, testing & successful commissioning and handing over to CDRI the complete Integrated Purified Water System for Laboratory on item rate contract.

The work shall be executed as per specifications and applicable standards.

These specifications shall be read in conjunction with the General Conditions of Contract, Additional Conditions of Contract and BOQ.

Power supply of 3 phase, 415 Volts, 50 Hz, AC shall be provided at one point by EPI / CDRI for group testing & commissioning of complete Integrated Purified Water System after erection is completed. However, the contractor shall make his own arrangements for power required during construction, fabrication, erection & trial run etc.

2.0 TECHNICAL SPECIFICATIONS OF INTEGRATED PURIFIED WATER SYSTEM FOR LABORATORY

2.1 GENERAL

For the new upcoming facility of CDRI at Sitapur Road, Lucknow, the laboratories are being built and infrastructure being completed. With regards to utility requirement, the integrated purified water system shall be used for analysis in CDRI New Campus. This water shall be used in three sections of the labs namely Chemical, Pre-clinical and Molecular Biology. The water source at CDRI site is from bore well. The water quality needed by CDRI for analysis in their laboratories is equivalent to single distilled purified water. The water quality required by Chemical section is as per 'Laboratory Water Type III'. This is in accordance with ASTM D1193 -91. This system is specially designed to meet CDRI water quality requirements. The integrated purified water system is required to meet CDRI's water quality requirements and to produce consistent quality of water through out the life of the system.

2.2 SYSTEM DESCRIPTION

Water is utilized for washing, preparation of lab units for operations, for preparation of distilled water and purified water (ultra-pure water). The water system comprises of feed pump with ion exchange system. This ion exchange system in turn comprises of dual media filter, activated carbon bed, cation exchanger, anion exchanger and mixed bed polisher. This treated water is then sent to a storage tank through a 40 micron filter. This tank is made of stainless steel construction with recirculation pump. The user points are then feed from the discharge of the storage tank downstream of the pump. This water shall be kept under continuous re-circulation as the water cannot be stagnant for more than 2 hours.

Water quality as per Chemical section is as per 'Laboratory Water Type III'. This is in accordance with ASTM D1193–91. Purified Water Generation Plant shall have 1 no. main Reservoir of 4000 Ltrs Capacity. Purified Water Generation Plant is located at Ground Floor with main reservoir Tank. Thereafter, the purified water shall be pumped to each floor of each Building / Laboratory having one user point in each lab. All piping, Valves and fitting shall be of SS 316 of internally electro polished grade only. Welding shall be Argon TIG Welding method from Qualified Welder. Piping size for main header shall be 1.0" and tapping header of ½" size of SS 316 Material with inside electro polished along with all fitting and valves etc. Capacity of Purified Water plant shall be 300 LPH with Operation ON AS REQUIRED basis. System shall be fully automatic with instrumentation like Pressure Gauges, Water Flow Meter with totalizer, Conductivity meter and Level Controller and pH indicator. Maximum operating working Pressure of Plant shall be 4 Bars. Valves shall be Ball Valves type for floor Isolation and Loop Valves for point of use make of reputed make. Design details of each equipment / instruments etc shall be as indicated in next section. The system shall be an in-built auto-dumping facility in case the temperature and/or conductivity of the feed water do not meet the required quality parameters. Pressure switches shall be mounted on all the incoming process lines for monitoring the supply utilities. In case of a pressure drop or non-availability of utilities, an alarm shall be generated. Two conductivity sensors shall be provided in the feed water and treated

water lines. The conductivity sensor shall be connected to an analyzer cum transmitter to generate a 4-20mA input to the PLC. The control cabinet shall be provided with a main isolator for the three-phase supply and a separate switch for the control supply. All cabling shall be flexible, PVC cabling routed via PVC channels mounted in the panel. All cabling for temperature and conductivity signals shall be shielded for minimum electro-magnetic interference. Necessary relays, contactors, MCB's, etc. shall also be mounted in the control panel. The service and maintenance area is provided with a lighting fixture, plug, and socket. The control system shall be provided with manual back up in case of PLC failure. Here all valves, pumps, etc. can be operated via switches.

2.3 OPERATION PRINCIPLE OF THE WATER SYSTEM.

The water from central storage (raw water tank) shall be pumped to first section of the integrated purified water system i.e. the ion exchange treatment system. The water shall be treated to remove any coarse solids using the dual media filter. The water is then treated in series to remove any odours /colours and any organic content using activated carbon filter. The water free from coarse solids, odours, colours and organic content is processed in cation exchanger bed followed by anion exchanger bed to remove TDS. The treated water is then polished through a mixed bed polisher. The purified water shall be filtered through a 40 micron filter to ensure no carry over from ion exchange system. The water after treatment shall be then directed to stage 2 of IPWS i.e. the storage tank and distribution system. This water shall be kept under continuous re-circulation as the water cannot be stagnant for more than 2 hours. Consequently, this water will be used at user locations.

2.4 PROCESS DATASHEET & DETAILED TECHNICAL SPECIFICATION

a) Process Datasheet

- Water usage per day
 - o 10 Ltrs per Lab per day X 8 Labs per Floor X 3 floors per building X 6 buildings
 - o 1440 Liters per day
 - o 1 Point in each Room near Wash Basin
- Operating flow rate
 - o 240 LPH
 - o 5.76 m³/day
- Design Flow Rate
 - o 300 LPH
 - o 7.2 m³/day
- Main Tank Capacity
 - o Measured volume : 4400 liters
 - o Available volume : 4000 liters

- Piping Requirement
 - o SS 316 with internal electro – polish
- Mode of Operation
 - o Fully Automatic (including regeneration)

AUTO-DUMPING FACILITY

The system has an in-built auto-dumping facility in case the temperature and / or conductivity of the feed water does not meet the required quality parameters.

PRESSURE SENSORS

Pressure switches are mounted on all the incoming process lines for monitoring the supply utilities. In case of a pressure drop or non-availability of utilities, an alarm is generated.

CONDUCTIVITY SENSORS

Two conductivity sensors are provided in the feed water and treated water lines. The conductivity sensor is connected to an analyzer cum transmitter to generate a 4-20mA input to the PLC.

ELECTRICAL SWITCH GEAR

The control cabinet is to be provided with a main isolator (MCCB) for the three-phase supply and a separate switch for the control supply. All cabling is flexible, PVC cabling routed via PVC channels mounted in the panel. All cabling for temperature and conductivity signals is shielded for minimum electro-magnetic interference. Necessary relays, contactors, MCCB's, etc. are also mounted in the control panel. The service and maintenance area is provided with a lighting fixture, plug, and socket. Thickness of Sheet steel shall be 2mm CRCA minimum . Control wiring shall be done with 2.5 mm² flexible stranded copper wire & for PLC wiring, it shall be 1.0 mm². Minimum rating of contractor shall be 25A Aluminum Busbar with Heat Shrinkable Sleeve shall be provided. Busbar density shall be .8A /Sq mm for Aluminum. Degree of protection shall be IP54.

MANUAL BACK-UP

The control system is provided with manual back up in case of PLC failure. Here all valves, pumps, etc. can be operated via switches.

SAFETY AND ALARMS

The process management system is provided with a series of safety and alarm features:-

- Utility failure alarm.
- Feed Water Conductivity high.
- Feed pump trip.

PROCESS RECORDING

Colour inkjet A4 printer for recording – date, time, process parameters, process status, alarms etc

FACTORY ACCEPTANCE TEST

After manufacture and in-house testing the machine shall be offered for customer inspection and testing as per in-house FAT protocol. The Protocol can be reviewed jointly and suitably amended within the limit of the code, if necessary prior to the schedule test runs.

APPROVAL OF DOCUMENTS

The following documents shall be submitted by the successful bidder for approval: -

- ❖ Maintenance and service manual.
- ❖ Design Document.
- ❖ Installation Document.
- ❖ Operational Document.
- ❖ Testing and Calibration Reports.
- ❖ Layout for plant

3 TECHNICAL SPECIFICATIONS

(i) Details of Integrated Purified Water System:

No	Description	
1.	Source of the Water	Bore Well Water
2.	Raw Water Inlet Ionic load on each exchanger	100.00 ppm
3.	Operation of plant	Automatic
4.	Per day operation	8.00 hrs.
5.	Plant flow	500 lit/hr.
6.	Plant output between two regenerations	10.0 3

(ii) LIST OF EQUIPMENTS

No	Description	Qty	Remarks
1.	Raw water Feed tank	1.00	1500 liters
2.	Dosing Tank	1.00	20 liters
3.	Chemical Tank	1.00	25 liters
4.	Feed Pump	2.00	1 working + 1 stand by
5.	Dual Media Filter	1.00	500 lit/hr.
6.	Activated Carbon Filter	1.00	500 lit/hr.
7.	Cation Exchanger	1.00	500 lit/hr. 10 m3 OBR
8.	Anion Exchanger	1.00	500 lit /hr. 10 m3 OBR
9.	Mix Bed Polisher	1.00	500 lit /hr. 10 m3 OBR
10.	Cartridge Filter	2.00	1 working + 1 stand by
11.	Purified water storage tank	1.00	1000 liters
12.	Purified water pump	2.00	1 working + 1 stand by
13.	Electrical Panel	1.00	Pump starters and instruments
14.	Interconnecting Pipe Line	1.00	Feed Water Pump → DMF → ACF → SAC → SBA→MB

(iii) LIST OF INSTRUMENTS

No	Description	Qty	Remarks
1.	Pressure Gauges	7.00 nos	2½" Dial Bottom connection 0 – 10 kgs/cm2 range
2.	Water Flow Meter with totalizer	1.00 no	At Mix Bed Polisher Out let
3.	Conductivity Meter	2.00 nos	Digital field mounted Anion and Mix Bed out let
4.	Level Controller	1.00 no	Treated Water Storage Tank
5.	pH Indicator	1.00 no	Field Mounted at Mix Bed Out let

(iv) RAW WATER FEED TANK

NO	DESCRIPTIONS	UNIT	
1.	Model		
2.	Diameter	MM	1000.00
3.	H O S	MM	1500.00
4.	Maximum Capacity	Liters	1000
5.	Maximum Operating Pressure	Kgs/cm2	4.00
6.	Hydro Testing of Pressure	Kgs/cm2	6.00
7.	Material of construction		
8.	Shell, Dish, Strainer Plate		SS 316
9.	Piping		SS 316
10.	Gasket		Natural Rubber
11.	Shell thickness	MM	5.00
12.	Dish Thickness	MM	5.00
13.	Pipe line size	NB	20.00

(v) PRE TREATMENT

No	Descriptions	Unit		
1.	Model			
2.	Diameter	MM	250.00	250.00
3.	H O S	MM	1800.00	
4.	Maximum Flow	Lit/hr.	500	
5.	Maximum Operating Pressure	Kgs/cm2	4.00	
6.	Hydro Testing of Pressure	Kgs/cm2	6.00	
7.	Material of construction			
8.	Shell, Dish		IS 2062	
9.	Piping		SS 304	
10.	Gasket		Natural Rubber	
11.	Shell thickness	MM	5.00	

12.	Dish Thickness	MM	6.00	
13.	Pipe line size	NB	20.00	
14.	Inlet Water Distribution		Bell Mouth	
15.	Water Collection		Strainer on plate	
16.	Media			
17.	Carbon	MM		900.00
18.	Anthracite	MM	300.00	
19.	Filtering Sand	MM	300.00	
20.	Silex	MM		75.00
21.	Gravels	MM	100.00	75.00
22.	Pebbles	MM	300.00	300.00

(vi) **EXCHANGERS**

No	Descriptions	Unit		
1.	Model			
2.	Diameter	MM	300.00	300.00
3.	H O S	MM	1500.00	
4.	Maximum Flow	Lit/hr.	500	
5.	Out Put Between two regeneration	M3	10.00	
6.	Resin Qty	Liters	60.00	60.00
7.	Regnrant qty. 100%	Kgs	4.25	4.80
8.	Maximum Operating Pressure	Kgs/cm2	4.00	
9.	Minimum pressure require for brine ejector	Kgs/cm2	1.50	
10.	Hydro Testing of Pressure	Kgs/cm2	6.00	
11.	Material of construction			
12.	Shell, Dish, Strainer Plate		IS 2062	
13.	Piping		SS 316	
14.	Gasket		Natural Rubber	
15.	Rubber Lining		IS 4682 Part I	
16.	Water Distribution / Collection		Strainer on Plate	
17.	Shell thickness	MM	5.00	
18.	Dish Thickness	MM	5.00	
19.	Strainer Plate	MM	8.00	
20.	Rubber Lining	MM	3.00	
21.	Pipe line size	NB	20.00	

(vii) MIX BED POLISHER

No	Descriptions	Unit	
1.	Model		
2.	Diameter	MM	300.00
3.	H O S	MM	1600.00
4.	Maximum Flow	Lit/hr.	500
5.	Out Put Between two regeneration	M3	10.00
6.	Resin Qty	Liters	15.00 25.00
7.	Regenerant qty. 100%	Kgs	1.05 2.00
8.	Maximum Operating Pressure	Kgs/cm2	4.00
9.	Minimum pressure require for brine ejector	Kgs/cm2	1.50
10.	Hydro Testing of Pressure	Kgs/cm2	6.00
11.	Material of construction		
12.	Shell, Dish, Strainer Plate		IS 2062
13.	Piping		SS 316
14.	Gasket		Natural Rubber
15.	Rubber Lining		IS 4682 Part I
16.	Water Distribution / Collection		Strainer on Plate
17.	Shell thickness	MM	5.00
18.	Dish Thickness	MM	5.00
19.	Strainer Plate	MM	8.00
20.	Rubber Lining	MM	3.00
21.	Pipe line size	NB	20.00

(viii) CARTRIDGE FILTER

NO	DESCRIPTIONS	UNIT	
1.	Model		
2.	Diameter	MM	200.00
3.	H O S	MM	800.00
4.	Maximum Flow	Lit/hr.	500
5.	Maximum Operating Pressure	Kgs/cm2	4.00
6.	Hydro Testing of Pressure	Kgs/cm2	6.00
7.	Material of construction		
8.	Shell, Dish, Strainer Plate		SS 316
9.	Piping		SS 316
10.	Gasket		Natural Rubber
11.	Shell thickness	MM	5.00
12.	Dish Thickness	MM	5.00
13.	Pipe line size	NB	20.00
14.	Filter Cartridge (1 per vessel)	Nos.	2.00
15.	Filter cartridge (dimension : OD X Length)	mm	150 500

(ix) **FEED PUMP**

NO	DESCRIPTIONS	UNIT	
1.	Normal Flow rate	Lit/hr.	300
2.	Head	kg/cm2.g	4.0
3.	Maximum Flow	Lit/hr.	500
4.	Maximum Operating Pressure	kg/cm2.g	4.00
5.	Hydro Testing of Pressure	kg/cm2.g	6.00
6.	Material of construction (contact parts)		CAST STEEL

(x) **RECIRCULATING PUMP**

NO	DESCRIPTIONS	UNIT	
1.	Normal Flow rate	Lit/hr.	300
2.	Head	kg/cm2.g	4.0
3.	Maximum Flow	Lit/hr.	500
4.	Maximum Operating Pressure	kg/cm2.g	4.00
5.	Hydro Testing of Pressure	kg/cm2.g	6.00
6.	Material of construction (contact parts)		SS316

BILL OF QUANTITIES

One set		Raw Water Feed Pump assembly
	Two Nos	Raw Water Pump Mono block constructed
	Two Nos	Suction strainers Y type
	Two Nos	Suction Isolation Valve
	Two Nos	Outlet Isolation Valve
	One No	Pressure Indicators Installed on common header
One set		Dual Media Filter
	One No	Mild Steel constructed vertical Pressure Vessel
		Vessel Internally Anti corrosive Painted
		Vessel Externally Epoxy Painted
	One No	Frontal Pipe line SS 304 constructed, suitable for Multifunctional Valve
	One No	Multifunctional Valve Assembly
	One Lot of	Initial fill of Filter Media as mentioned in the technical specification sheet
	One No	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm2)
	One No	Sample SS Needle Valve
One set		Activated Carbon Filter
	One No	Mild Steel constructed vertical Pressure Vessel
		Vessel Internally Anti corrosive Painted
		Vessel Externally Epoxy Painted

	One No	Frontal Pipe line SS 304 constructed, suitable for Multifunctional Valve
	One No	Multifunctional Valve Assembly
	One Lot of	Initial fill of Filter Media as mentioned in the technical specification sheet
	One No	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm ²)
	One No	Sample SS Needle Valve
One set		Strong Cation Exchanger
	One No	Mild Steel constructed vertical Pressure Vessel
		Vessel Internally Rubber lined as per IS 4682 Part I, 3.00 mm thick
		Vessel Externally Epoxy Painted
	One No	Frontal Pipe line SS 316 constructed, suitable for Multifunctional Valve
	One No	Multifunctional Valve Assembly
	One No	Ejector for Regnrant suction
	One Lot of	Initial fill of Strong Cation H ⁺ Resin. Qty as mentioned in the technical specification sheet
	One No	Regeneration Tank
	One No	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm ²)
	One No	Sample SS Needle Valve

One set		Strong Base Anion Exchanger
	One No	Mild Steel constructed vertical Pressure Vessel
		Vessel Internally Rubber lined as per IS 4682 Part I, 3.00 mm thick
		Vessel Externally Epoxy Painted
	One No	Frontal Pipe line SS 316 constructed, suitable for Multifunctional Valve
	One No	Multifunctional Valve Assembly
	One No	Ejector for Regenerant suction
	One Lot of	Initial fill of Strong Anion Cl- Resin. Qty as mentioned in the Technical specification sheet
	One No	Regeneration Tank
	One No	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm ²)
	One No	Sample SS Needle Valve
	One No	Digital on line field mounted conductivity meter
One set		Mix Bed Polisher
	One No	Mild Steel constructed vertical Pressure Vessel
		Vessel Internally Rubber lined as per IS 4682 Part I, 3.00 mm thick
		Vessel Externally Epoxy Painted
	One No	Frontal Pipe line SS 316 constructed, suitable for Multifunctional Valve
	One No	Multifunctional Valve Assembly
	Two Nos	Ejector for Regenerant suction
	One Lot of	Initial fill of Strong Cation H+ and Strong Anion Cl- Resin. Qty as mentioned in the technical specification sheet
	One No	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm ²)
	One No	Sample SS Needle Valve
	One No	Digital on line field mounted conductivity meter
	One No	Flow Meter with totaliser
One set		Cartridge Filter
	Two Nos	Stainless Steel constructed vertical Pressure Vessel
		Vessel design as per ASME SEC VIII, DIV 1 (Latest Ed.)
		Vessel Externally Epoxy Painted
	Two Nos	Vent valves
	Two Nos	Drain valves
	Four Nos	Isolation Valve
	Two Nos	Pressure Indicator (2½" Dial, Glycerin Fill 0-7 kgs/cm ²)
	Two Nos	Sample SS Needle Valve

One Lot		Common
	One No	Mild Steel constructed, fabricated from 'I'-channel skid
	One No	Crca sheet steel constructed electrical panel
	One No	PVC common drainage system
	One No	Integrated Purified Water System out let isolation valve (PP constructed)
	One no	SS 316 constructed cylindrical vertical type Integrated Purified Water System storage tank.

4.0 LIST OF INDICATIVE MAKES

The following is the list of products and indicative makes. Bidder is free to propose any other equivalent Make meeting Technical Requirements, Specifications alongwith required details in support of the same. The same would be analyzed and accepted if found suitable after discussion between EPI and bidder. The Makes shall be finalized during Technical evaluation prior to opening of Price-Bids.

Bidders are required to offer reputed equipment / component which is strictly meeting technical requirements, enclosed specifications alongwith NIT and other relevant / latest applicable Standards & Rules.

No	Description	Indicative Makes
1.	DM Plant	Thermax/ ION Exchange/Siemens
2.	Resin	Auctel / Thermax / ION Exchange
3.	Anti Rust (X-ceed 520TM)	Eximious / Shreeyantra
4.	Pressure Gauge	Mass / Precision / Wika / BRC / GIC / Italtec
5.	Valves	Innovative / UKL / Shenco / Audco / GG valves
6.	Raw Water/Recirculation Pumps	Jyoti / Beacon / KSB / Kirloskar / Flowserve
7.	Instruments	Watts / Vaturkar / NK Instruments / AN Instruments / H Guru
8.	SS 316 pipes	Ratnamani / Remi / Sumitumo / Surya / Jindal
9.	Cartridge Filter	Pall / Peco / Parker

5.0 DRAWINGS AND DATA:

The routing of piping of water system & Report of water sample and analysis are as per attached drawings.

Sr. No.	Description	Drg. No.
1	P & I D for Laboratory Ground Floor Plan Purified Water Line	CDRI / NI – 499 /001
2	Report of water sample and analysis	

6.0 **GENERAL GUIDELINES FOR PIPING**

- * Piping layout is dictated by the relative locations of connecting user points.
- * Adequate number of drain and vents shall be provided as per the system / layout & pid requirements
- * Valves shall be located and oriented such a way that these are easily accessible for operation and maintenance.
- * While providing openings in floor/walls for pipe crossing due care shall be taken for the pipe thermal movement and insulation thickness.

Corrosion Allowance

The following minimum allowance for corrosion of piping shall be provided for surfaces to be contacted with service fluid. The detail shall be in accordance with Engineering Specification H-103, "Piping Materials".

(1) Carbon steel	: 1.0 mm
(2) Low alloy steel	: 1.0 mm
(3) High alloy steel (Stainless Steel, etc.)	: 0 mm
(4) Non-ferrous material	: 0 mm
(5) Non-metallic material	: 0 mm

Nominal Size of Piping

Minimum size of piping shall be NPS 15 NB, unless otherwise noted.

6.1 **PIPING COMPONENTS**

a) Pipes

For straight run portions of piping systems, pipes shall be applied.

b) Elbows, Bends and Miters

- (1) Change in direction of piping systems shall be made with elbows, bends or miters.
- (2) When bend is applied, the material specification shall be as same as pipe. The bend radius shall be reasonably decided considering reduction of the thickness.
- (3) Miters fabricated from pipes may be applied under following conditions. In this case, a maximum angle between adjacent miter axes shall be 22.5 degree.
 - (i) 10 kgf/cm²G [1 MPa (gauge)] and under, for temperature upto 200°C.
 - (ii) 7 kgf/cm²G [0.7 MPa (gauge)] and under, for temperature above 200°C upto 260°C.

- (4) Long radius elbows shall generally be used for piping for NPS 2 and over, except where design requirements dictate the application of short radius elbows.

c) Reducers

- (1) Change in piping sizes shall be made with reducers.
- (2) Reducer shall generally be of concentric type except on Pipe Rack or wherever specified.

d) Branch Connections

- (1) Branch connection of piping shall be made with branch materials (components) such as smooth or fabricated tees, half-couplings, welding outlets, etc, or welded pipe-to-pipe connection.
- (2) If wall thickness of pipe is insufficient to sustain the pressure and thermal stress in case that welded pipe-to-pipe branch connection is applied, a reinforcement pad shall be provided at the nozzle weld portion.
- (3) When welded pipe-to-pipe branch connection is applied, piping shall be designed so that the angle of intersection between the branch and the run (header) is not less than 45 degree.

e) Flanges

Flanges shall be applied for piping connections at flanged equipment nozzles and in-line piping elements such as valves, strainer, instruments, etc. However, as an exception, flanges shall also be provided for following cases:

- (1) Where frequent dismantling of piping is required.
- (2) Where plastics, non-metallic, cast iron or lining piping systems can not be welded or otherwise jointed except by flanges.
- (3) Where mentioned in P & ID for every change of direction for chemical cleaning.

f) Valves

- (1) Valves shall be provided according to P&I and for isolation of piping system, flow control, etc.
- (2) Type of valves to be applied shall be in accordance with P&I
- (3) Valves shall be installed on the place considering the operability.

g) End Closures

Piping ends shall be closed with plugs, caps or blind flanges.

h) Blanks

Blanks shall be provided to the extent as shown on P&I in order to realize complete isolation of piping systems.

i) Strainers

Strainers shall be provided to the extent as shown on P&I.

j) Connection of Piping

(1) Piping shall generally be connected in the following manner.

- (i) For piping of NPS 2 and over, piping materials (components) shall be welded each other directly.
- (ii) For piping of NPS 1 1/2 and under, socket welded or screwed type components shall be applied for the connection.

(2) Seal welding shall generally be applied to all the screwed connections except where frequent opening is required.

k) Material Specification Change

When a piping is connected to another piping of different material specification (material, pressure rating, etc) the class break shall generally be accomplished at the valve or the flanged joint.

(1) As a rule, the valve or the flanged joint shall be included in the higher material specification between the two, unless otherwise indicated on the P&I.

(2) Dissimilar welding shall be avoided as far as possible.

6.2 DESIGN OF PIPING SYSTEMS

a) Piping Route

Piping shall be routed for the shortest possible run with minimum number of fittings consistent with provision for expansion and flexibility. The assembly, removal and support of piping and equipment shall also be taken into consideration.

b) Allocation of Piping

(1) All piping in plant, except drain piping, sewer piping and other special use piping, shall be grouped on overhead pipe-racks. Piping that can not be allocated on overhead pipe-racks physically shall be run on sleepers or in pipe trenches with following considerations.

c) Side Clearances of Pipes

(1) To permit ready access for the removal and/or maintenance of a piping, a minimum side clearance of 25 mm shall be provided between piping. Thermal movements, thickness of insulation to be applied and the maximum diameter of flanges shall be considered in determining allocation of piping with side clearances. Space for the connection of instrument piping/tubing to in-line instruments shall also be considered.

(2) A minimum side clearance between piping and structure shall be 50mm

d) Installation of Valves

(1) Valves shall generally be installed in horizontal piping with upward handle direction. However, when the valve installation is not reasonable by some reasons such as space limitation in piping arrangement, operability of the valves etc., valves shall be installed in vertical piping.

(2) Valve stem shall generally not be directed downward against horizontal line.

(3) The minimum clearance between valve hand-wheels shall generally be 100mm. However, small size valves of NPS 1 1/2 and under may be installed so that the minimum clearance between their hand-wheels is 50mm.

e) Utility Piping Systems

(1) Branch lines from headers of various utilities (such as Vacuum, Purified water etc) shall generally be taken from the top of the header.

6.3 Pump Piping

a) General

(1) Piping around pumps shall be arranged so that ready operation and maintenance is realized with keeping necessary space.

(2) Draining of suction and discharge piping can be accomplished through a drain port of pump casing, as far as possible. If it is impracticable due to the piping figure or other reasons, drain connection shall be provided at the lowest point of the piping.

b) Suction Piping

(1) Pump suction piping shall be arranged to minimize pressure drop and to avoid pockets.

(2) Where size adjustment is required between the connection piping and pump nozzle, a reducer shall be applied as follows:

(i) The reducer shall be located close to pump nozzle.

(ii) Type of reducer shall generally be of eccentric with top flat use except for special services such as slurry.

(3) Where the P&I instructs, strainers shall be installed in pump suction piping.

c) Discharge Piping

(1) The discharge piping shall have a check valve between the pump nozzle and a block valve.

(2) Care shall be taken for the arrangement of discharge piping so as not to disturb the maintenance works of pumps and their drivers.

6.4 SITE LAYOUT

a) Unloading and Loading Facilities

Unloading and loading facilities should be located in the edge of the site near the point of entry (i.e. near the rail spur or pier).

b) Utility Facilities

Supply facilities of utilities, that is, water, air, electricity, etc should be located near process main unit as much as possible keeping adequate safety requirements.

6.5 SAFETY DISTANCE

Followings are general requirements concerning safety distance of plant facilities. If applicable safety code requirements are more severe, the code requirements shall govern.

- (1) Pumps and compressors handling flammable materials, which are expected to leak shall be located a minimum 15 m away from fired equipment. Other than pumps and compressors, the distance may be reduced to a minimum 8 m.
- (2) Equipment such as towers, vessels taller than the end points of the fire stack should not be located within 50 m radius of such discharge ends.
- (3) Equipment and piping handling flammable materials shall not be placed within 15 m of building such as control room, switch room etc.
- (4) Oxygen manufacturing unit, if any, shall be away 10 m or more from equipment handling flammable materials.
- (5) Large electrical equipment such as switch gears, should not be placed in hazardous area. Classification and spacing requirements concerning the hazardous area shall be in accordance with applicable codes.

6.6 All 90 deg elbows shall be long radius. If impractical, the application of short radius elbows shall be clarified

a) Piping route

- (1) Piping shall be routed such that the optimum piping layout is achieved in terms of process requirements, ergonomics, operation, inspection and maintenance. Having considered these factors, the number of flanges, fittings, valves and welds shall be minimized.

7.0 GENERAL TECHNICAL SPECIFICATIONS OF PIPES AND FITTINGS

SERVICE : WATER

		PIPING MATERIAL SPECIFICATION						
		SERVICES:			PIPE CODE : S6			
		WATER						
					SHEET : 01	REV: 0		
						PREP	CHKD	APPD
DESIGN CONDITIONS		PRESS. RATING : 150#			TYPE OF MATERIAL	MAX. PRESSURE (kg/cm2) : 6		
		CORR. ALLOW: 1.5mm			STAINLESS STEEL	MAX/MIN TEMP(°C):200 TO (-20)		
ITEM	DESCRIPTION	NPS (MM)	RATING	TYPE	MATERIAL			REMARKS
PIPE	PIPE	15 - 40	SCH-40	SMLS	ASTM A 312 TP 304/316	STAINLESS STEEL		ASME B 36.19
		80 - 100	SCH-10					
JOINTS	LINE	15-40	3000#	SOCKET WELD	FORGED ALLOY STEEL, ASTM A 182 GR.F 304/316			ASME B 16.11
		50-100	SAME AS PIPE	MSLS B.W.	A 403 GRWP 304/316			ASME 16.9 ASME B 16.25
	FLANGES	15-40	150#	SOCKET S.W. RF	FORGED ALLOY STEEL, ASTM A 182 GR.F 304/316			ASME 16.5 MSS - SP - 83
								ASME B 16.25 / 16.5
	STUD BOLTS	ALL SIZES	-----	FULL TREAD	ASTM A 193 GR.B7	ALLOY STEEL		A3.560.1
	NUTS			HVY. HEX.NUT	ASTM A 194 GR.2H			
	GASKETS	25-100	150#	RING FACE	3.15 mm	PTFE ENVELOPED, NON-ASBESTOS SYNTHETIC FIBER		G 81 ASME B 16.21 A3.425.2
FITTINGS	ELL, TEE & REDUCER	15-40	3000#	SOCKET WELD	FORGED ALLOY STEEL, ASTM A 182 GR.F 304/316			ASME B 16.11
		50-100	SAME AS PIPE	MSLS B.W.	A 403 GRWP 304/316			ASME B 16.25
	BRANCH CONN.	15-40	3000#	SOCKET WELD	FORGED ALLOY STEEL, ASTM A 182 GR.F 304/316			SEE BRANCH CONN.TABLE

ITEM	DESCRIPTION	NPS (MM)	RATING	TYPE	MATERIAL	REMARKS
	PSV	15-25	800#	SOCKET WELD		A182GR.F304/316
		40-250	800#	FLANGED RAISED FACE		A351GR.CFM/304/316
		50-250		FLANGED RAISED FACE		A351GR.CFM/304/316
	BALL	15-25	150#	SOCKET WELD		A182GR.F316L/304316
		40-250		FLANGED RAISED FACE		A351GR.CFM/304/316
	NRV	15-25	150#	SOCKET WELD		A182GR.F316L/304/316
		40-250		FLANGED RAISED FACE		A351GR.CFM/304/316
	FLUSH BOTTOM VALVE	15-20	150#	SCREWED END		A182GR.F304/316
		25-250		FLANGED RAISED FACE		A351GR.CFM/304/316
STRAI NERS	"Y" TYPE	15-20	600#	SCREWED END PT	REFER COMPONENT SPECIFICATI ON SHEET	ST-11A
		25-40	150#	FLANGED RAISED FACE		ST-12A
	BUCKET	50-500	150#			ST-12X

NOTE :

1 LEAK TEST:

PER ASME B31.3 SECTION 345, SEE PRODUCT & SERVICE INDEX
FOR TEST
MEDIUM & PRESSURE

2 WELDING:

GAS TUNGSTEN ARC (GTAW), GAS METAL ARC (GMAW), SHIELDED METAL ARC (SMAW)

3 WELD EXAMINATION:

VISUAL AS PER ASME B31.3 SECTION 341.4.2

4 Any other makes shall be subject to approval from EPI.